UNIT 1

Thinking Geographically

Chapter 1 *Maps and Geographic Data*

Chapter 2 *Spatial Concepts and Geographic Analysis*

Unit Overview

What distinguishes geography from all other fields is its focus on a particular perspective, or way of looking at things. That distinctive perspective is spatial and a concern for the interactions between humans and the physical environment. Geographers are certainly interested in *where* questions, but more importantly, they focus on the *why there* question, often expressed as "the why of where."

A spatial approach considers the arrangement of the phenomena being studied across the surface of the earth. The course's Big Ideas (see pages xxiv–xxv), Four-Level Analysis (described below through page 3), and the five skill categories (see pages 3–7) will serve as reliable frameworks for understanding topics from a geographic perspective.

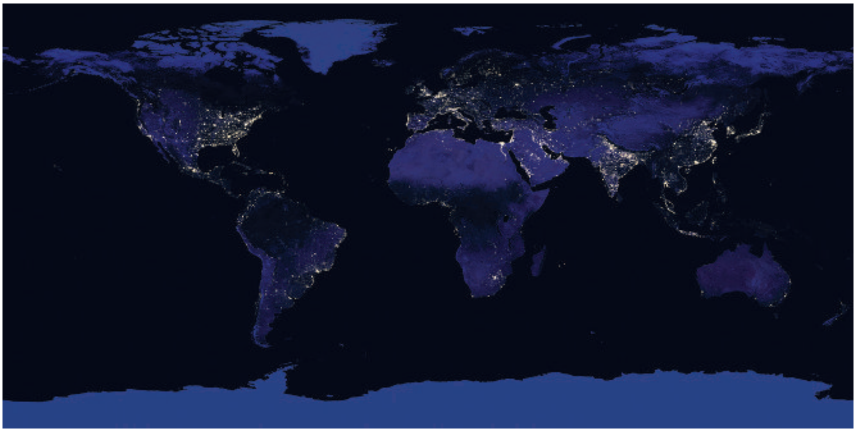
Branches of Geography

Geography is commonly divided into two major branches that bridge the gap between the physical and social sciences:

- **Physical geography** is the study of the spatial characteristics of various elements of the physical environment. Physical geographers study topics such as landforms, bodies of water, climate, ecosystems, and erosion.
- **Human geography** is the study of the spatial characteristics of humans and human activities. Human geographers study topics such as population, culture, politics, urban areas, and economics.

Four-Level Analysis Spatial Framework

Location is at the heart of all geographic understanding. The thinking skills used by geographers help them understand why things and people are where they are, and why the location of an item or of people with particular traits are important. The **Four-Level Analysis** spatial framework will guide your thinking, provide an approach to spatial thinking, and help you think like a geographer. You will use this process when looking at a map, chart, graph, data table, landscape, or an image such as Earth at night (shown on the following page).



Source: nasa.gov

2016 global scale Earth at night

FOUR-LEVEL ANALYSIS SPATIAL FRAMEWORK		
Level	**Key Questions**	**Possible Answers for Earth at Night Image Above**
Comprehension L1	*What?* *Where?* *When?* *Scale?* *Source?*	▪ What? Earth at night ▪ Where? Earth ▪ When? 2016 ▪ Scale? Global scale ▪ Source? nasa.gov
Identification L2	*Are there patterns in the source?* The source could be a map, chart, graph, etc. There could be multiple patterns.	Numerous patterns ▪ Coasts are brighter than interior ▪ Northern Hemisphere is brighter than Southern Hemisphere ▪ Eastern China is brighter than Western China
Explanation L3	Pick a pattern from the source and explain: *Why did this pattern occur there?* or *How did this pattern occur?* You will use the content of the course to help answer these questions.	Why do so many people live near the coasts? Access to global trade networks or natural resources from oceans (fish), which results in more job opportunities, income, and food. The interior often has harsher climates (deserts or cold) and often less access to natural resources.
Prediction L4	*What will be the impact on the economy, society, politics, or the environment?* or *What if the pattern continues into the future?* Describe the impact or effects and make predictions.	Impacts: ▪ *Economic*—Cost of living (rent) is higher on the coasts because of the high demand for housing. ▪ *Environmental*—Human and factory waste can pollute the ocean, killing fish and wildlife.

The chart on the previous page is designed to be just an introduction to the process with relatively simple responses and is not meant to include all possible answers. The depth and quality of responses should improve as you develop a deeper understanding of human geography. Throughout the text, references will be made to the different levels by using L1, L2, L3, or L4.

Essential Geography Skill Categories 1–5

The AP® Human Geography exam will require students to not only learn the content and discipline-specific language of the course, but utilize and apply a set of essential skills to demonstrate their understanding of human geography. This section introduces these skills and prepares students to apply these skills using real world scenarios across all units of the course and both parts of the exam.

Skill Category 1: Concepts and Processes

Analyze geographic theories, approaches, concepts, processes, or models in theoretical and applied contexts.

This skill contains a large amount of the content of the course and is the most tested skill on the exam:

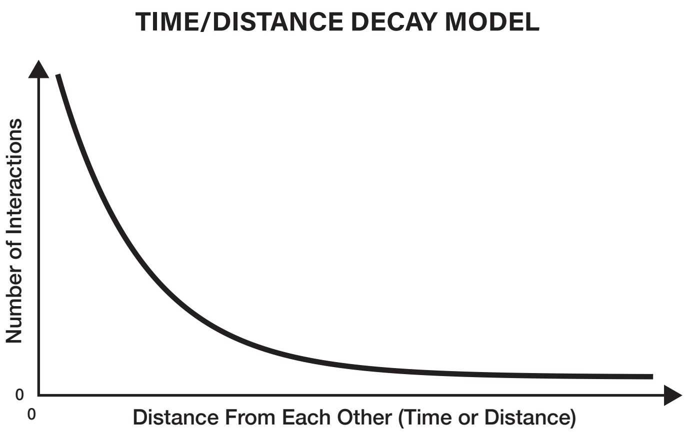
- **Analyze** means to break down into parts and study each part carefully.
- A **theory** is a system of ideas and concepts that attempt to explain and prove why or how interactions have occurred in the past or will occur in the future.
- **Concepts** are key vocabulary, ideas, and building blocks that geographers use to describe our world.
- **Processes** involve a series of steps or actions that explain why or how geographic patterns occur.

Models in Geography The most important element of this skill involves understanding and applying geographic models. Geographers, similar to biologists, meteorologists, and others who deal with complex reality, create geographic models. **Models** are representations of reality or theories about reality, to help geographers see general spatial patterns, focus on the influence of specific factors, and understand variations from place to place. Models help explain, describe, and sometimes even predict spatial activity and phenomena. There are two basic types of geographic models—spatial and nonspatial:

- **Spatial models** look like stylized maps, and they illustrate theories about spatial distributions. Spatial models have been developed for agricultural and urban land use, distributions of cities, and store or factory location.
- **Nonspatial models** illustrate theories and concepts using words, graphs, or tables. They often depict changes over time rather than across space with more accuracy than spatial models.

Data Driven Models (Formulas and Graphs) Geographers use mathematic formulas to help them understand how the world works. These formulas function much like models. Some formulas, such as those that determine crude birth and death rates, doubling times for populations, and population densities, are mathematical calculations that are used to produce a statistic.

One model that helps explain some patterns evident on the Earth at night image is what geographers call **time-distance decay**. Basically, the idea is that things, such as cities, near each other are more closely connected or related than things that are far apart, as shown in the graph below. The bright lights on the border between the United States and Mexico on the Earth at night map are partly explained because the lights show cities on both sides of the border. This illustrates the countries have lots of connections economically and culturally because they are close to each other.



The Time-Distance Decay Model illustrates decreasing interactions and connections as distance increases.

Applying Concepts and Processes In order to be successful in all elements of this skill, you will need to describe, explain, and compare concepts, processes, models, and theories. Students will have to apply the models in various contexts from around the world. The most challenging part of this skill will be to explain the strengths, weaknesses, and limitations of the model. Another way of saying this is, where a model works and where it doesn't work and explain why.

Skill Category 2: Spatial Relationships

Analyze geographic patterns, relationships, and outcomes in applied contexts.

Maps are the signature element of geography. Geographers examine maps to look for clues and patterns in the location and distribution of phenomena (L1 and L2). **Spatial patterns** refer to the general arrangement of things being studied. Describing these spatial patterns, networks, and relationships with precise language is critical to understanding spatial relationships. Geographers use specific terms—density, dispersion, clustered, scattered, linked, etc.—to communicate about locations and distributions.

Applying Spatial Relationships In order to be successful in this skill, students will view a source such as the North America at night image and then use the concepts, models, and theories to explain why and how the patterns on the image occurred (L3 and L4) and some likely outcomes (L4).

Geographers look at the networks, patterns, and relationships that exist between locations, how they evolve, and what their effects are. **Networks** are a set of interconnected entities, sometimes called nodes. The image below shows a network of cities that are connected by numerous strings of lights. These lights follow highways, rail lines, or river routes of transportation and illustrate a connectiveness to U.S. urban and transportation systems.

The last element of this skill requires explaining the degree to which a geographic concept or model effectively describes or explains expected outcomes. This skill requires a deep understanding of different regions of the world and an ability to understand the strengths and weaknesses of various models and theories.

Source: nasa.gov
2016 North America at night

Skill Category 3: Data Analysis

Analyze and interpret quantitative geographic data represented in maps, tables, charts, graphs, satellite images, and infographics.

Quantitative data is any information that can be measured and recorded using numbers such as total number of immigrants to a city. More specifically, **geospatial data** is quantitative and spatial. It has a geographic location component to it such as a country, city, zip code, latitude, longitude, or address and is often used with geographic information systems (see Topics 1.2 and 1.3) because it lends itself to analysis using formulas and is mappable. An example would be average annual income by country.

Applying Data Analysis This skill is similar to Skill 2 except it involves interpreting quantitative statistical data expressed in numbers. This numerical data can be shown in a variety of ways, and examples include life expectancy, income, birth rate, etc. If the data is shown in a map, describing the spatial pattern (L2) accurately and with precision is critical for analysis. If the data is in a graph or chart, describing the variables and trend on the graph or chart (L2) is very important to an accurate interpretation.

The data analysis skill requires the use of concepts, models, and theories to explain why and how these patterns occurred (L3) and some likely outcomes and/or impacts (L4). Using the global scale Earth at night, you can use quantitative data, such as income, to explain why some places are brighter than others. Places that have higher income are more likely to afford electricity in their homes. But be careful, because a difference in income isn't the only reason why some places are bright or dark. Some of the dark areas may be difficult to live in due to extreme climates, such as the regions within the Sahara in northern Africa.

The most difficult part of this skill will be to recognize the limitations of the data. This will require an understanding of trustworthy sources of information, incomplete or inaccurate data, and possible mistakes in gathering the data.

Skill Category 4: Source Analysis

Analyze and interpret qualitative geographic information represented in maps, images (e.g., satellite, photographic, cartoon), and landscapes.

Qualitative sources are not usually represented by numbers. This data is collected as interviews, photographs, remote satellite images, descriptions, or cartoons. For example, asking people if they feel an intersection is dangerous is qualitative as is reviewing a photograph of a city's landscape.

Applying Source Analysis When viewing qualitative sources, you can use Four-Level Analysis to help guide your approach. Geographers look for the following elements: types of information within the source, patterns within a source, and similarities and differences between sources (L1 and L2).

Once this has been accomplished, geographers turn their attention to explaining the reasons why or how geographic concepts and ideas explain the patterns (L3) within the source and the possible impacts of the patterns (L4).

Like all data, there are limitations of visual and other qualitative resources such as only showing a part of the overall landscape, the time of day that the information was gathered, interviews that may include opinions not based on accurate information, or the author's lack of understanding of a culture's beliefs or values. In the case of the Earth at night image, one of the major limitations is that the image does not show lights where all people in the world live, just the places that can afford to have electricity. The image really only shows wealthier populations and larger cities where electricity is available.

Skill Category 5: Scale Analysis

Analyze geographic theories, approaches, concepts, processes, and models across geographic scales to explain spatial relationships.

One of the most powerful skills of geographers is changing **scales of analysis**, or looking at topics at the local, regional, country, or global scale. This process will be described in greater detail in Chapter 2 (see Topic 1.6), but essentially, changing scale of analysis involves studying phenomena by zooming in and zooming out in order to develop a more complete understanding of the topics being studied.

Applying Scale Analysis The Earth at night image can be used again to solidify your understanding. The map shows an image at the global or worldwide scale, and the pattern of more people living on the coast than the interior is a strong global scale pattern. However, the pattern that more people live in eastern China than western China is a country level scale of analysis. To take this one step further, a geographer could zoom into the local or city scale to see the border between the United States and Mexico, near San Diego. What is important is that at each scale, we may observe different patterns and reasons of why or how (L3) or the impacts (L4) that may be different or the same at each scale of analysis.

Source: nasa.gov

A zoomed in view of the U.S.-Mexico border showing San Diego, California, and Tijuana, Mexico.

Mastering the strategy of Four-Level Analysis spatial framework and the five essential skills of this course will take your ability to understand human geography to the next level.

ENDURING UNDERSTANDINGS

IMP-1: Geographers use maps and data to depict relationships of time, space, and scale.

PSO-1: Geographers analyze relationships among and between places to reveal important spatial patterns.

SPS-1: Geographers analyze complex issues and relationships with a distinctively spatial perspective.

Source: *AP® Human Geography Course and Exam Description*. Effective Fall 2020. (College Board).

CHAPTER 1

Maps and Geographic Data

Topics 1.1–1.3

Topic 1.1 Introduction to Maps

Learning Objective: Identify types of maps, the types of information presented in maps, and different kinds of spatial patterns and relationships portrayed in maps. (IMP-1.A)

Topic 1.2 Geographic Data

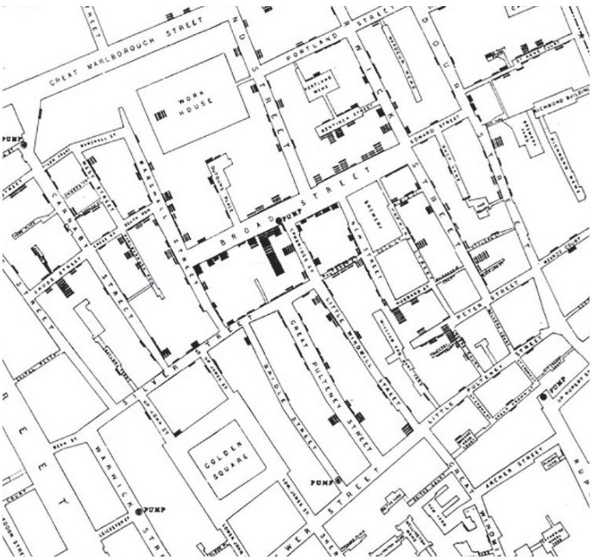
Learning Objective: Identify different methods of geographic data collection. (IMP-1.B)

Topic 1.3 The Power of Geographic Data

Learning Objective: Explain the geographical effects of decisions made using geographical information. (IMP-1.C)

The map—what a great idea!—is also one of the oldest and perhaps the most powerful and constant of geographic ideas. . . . Although they may be as beautiful as any work of art, we distinguish maps from art in the way we look at them. . . . The map's message does not lie in its overall effect but in the locational information it carries.

—Anne Godlewska, *Ten Geographic Ideas That Changed the World*



Source: Wikimedia Commons

John Snow used geographic reasoning to locate the source of a cholera outbreak to a water pump on Broad Street in London in 1854. The black dashes are cases of cholera. (See Topic 1.3 for how geographic data is used.)

1.1

Introduction to Maps

Essential Question: What information is presented in different types of maps, and how do those maps show spatial patterns, the power of geographic data, and relationships among places?

Geographers emphasize spatial patterns, which are the general arrangements of things being studied and the repeated sequences of events, or processes, that create them. Learning to recognize and use geographical patterns is a fundamental skill in understanding the discipline. One of the most important tools of geographers are maps. Improvements in geospatial and computer technologies have dramatically increased the quality of maps, the accuracy of data, and the variety of maps available to study and use. Maps and geospatial data now influence everyday life with the use of smartphones and apps that allow us to not only view maps but interact, modify, and show our own location within the map.

Maps

Maps are the most important tool of a geographer and help to organize complex information. No tool communicates spatial information more effectively than a map. Maps are essential in highlighting and analyzing patterns. There are two broad categories of maps: reference maps and thematic maps:

Reference Maps

Reference maps are aptly named because they are designed for people to refer to for general information about places.

- **Political maps** show and label human-created boundaries and designations, such as countries, states, cities, and capitals.
- **Physical maps** show and label natural features, such as mountains, rivers, and deserts.
- **Road maps** show and label highways, streets, and alleys.
- **Plat maps** show and label property lines and details of land ownership.

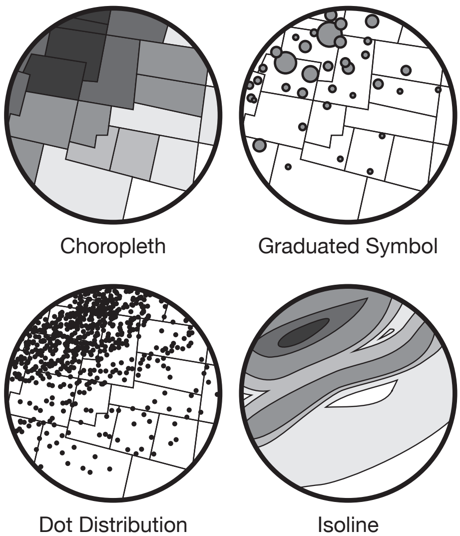
REFERENCE MAP OF MEXICO

Reference map of Mexico from 2020. What type of reference material is included in the map? For what purpose might this map be useful?

Thematic Maps

Thematic maps show spatial aspects of information or of a phenomenon. Following are descriptions of four common types of thematic maps.

MAP PATTERNS



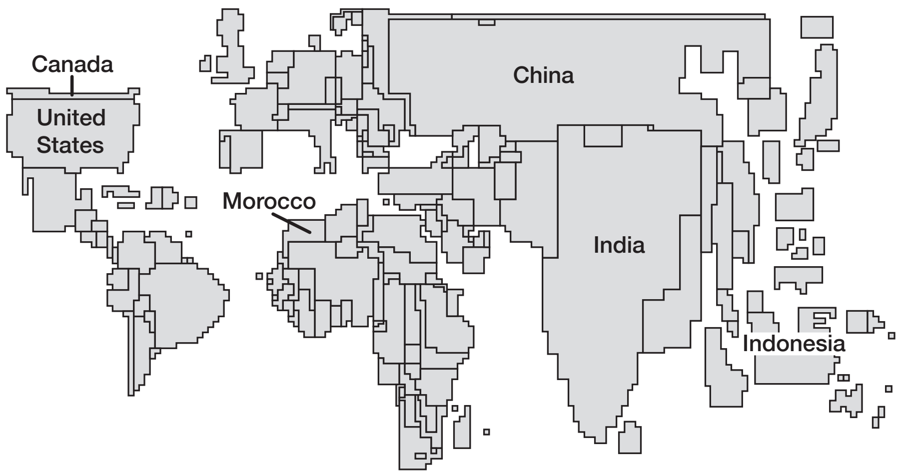
Choropleth maps use various colors, shades of one color, or patterns to show the location and distribution of spatial data. They often show rates or other quantitative data in defined areas, such as the percentage of people who speak English.

Dot distribution maps are used to show the specific location and distribution of something across a map. Each dot represents a specified quantity. One dot might stand for one school building or for millions of people who own dogs. While these maps are known as dot distribution maps, any kind of symbol—a triangle, the outline of a house, a cow—can be used instead of dots.

Graduated symbol maps use symbols of different sizes to indicate different amounts of something. Larger sizes indicate more of something, and smaller sizes indicate less. These maps make it easy to see where the largest and smallest of some phenomena are by simply comparing the symbols to each other. The map key is used to determine the exact amount. The symbols themselves are arranged on the map centered over the location represented by the data, so they may overlap. Graduated symbol maps are also called proportional symbol maps.

Isoline maps, also called isometric maps, use lines that connect points of equal value to depict variations in the data across space. Where lines are close together, the map depicts rapid change, and where the lines are farther apart, the phenomenon is relatively the same. The most common type of isoline maps are **topographic maps**, which are popular among hikers. Points of equal elevation are connected on these maps, creating contours that depict surface features. Other examples of isoline maps are weather maps showing changes in barometric pressure, temperature, or precipitation across space.

In a **cartogram**, the sizes of countries (or states, counties, or other areal units) are shown according to some specific statistic. In the example below, the cartogram of world population shows Canada and Morocco as roughly the same size because they have similar populations (about 35 million people), even though Canada is more than 20 times larger in area. Any variable for which there are statistics can be substituted for the size of the country and mapped in the same way. Cartograms are useful because they allow for data to be compared, much like a graph, and distance and distribution are also visible, like on a traditional map.



The size of each country reflects the total population. Based on the graphic, which countries have the largest populations?

Scale

Nearly every map is a smaller version of a larger portion of the earth's surface. In other words, a map is a reduction of the actual land area it represents. **Scale** is the ratio between the size of things in the real world and the size of those same things on the map. A map has three types of scale: cartographic scale, geographic scale and the scale of the data represented on the map. (See Topic 1.6 for more about scale.)

Cartographic scale refers to the way the map communicates the ratio of its size to the size of what it represents:

- Words: for example, "1 inch equals 10 miles." In this case, 2 inches on the map would be 20 miles on the surface of the Earth.
- A ratio: for example, 1/200,000 or 1:200,000. This means that 1 unit of measurement on the map is equal to 200,000 of the same unit in reality. For example, 1 inch on the map represents 200,000 inches (or 3.15 miles) on the ground.
- A line: for example, the map may show a line and indicate that its distance on the map represents ten miles in reality. This is sometimes called a linear, or graphic, scale.
- Scale: **Small-scale maps** show a larger amount of area with less detail—global scale Earth at night is an example. **Large-scale maps** show a smaller amount of area with a greater amount of detail—North America at night is an example.

Types of Spatial Patterns Represented on a Map

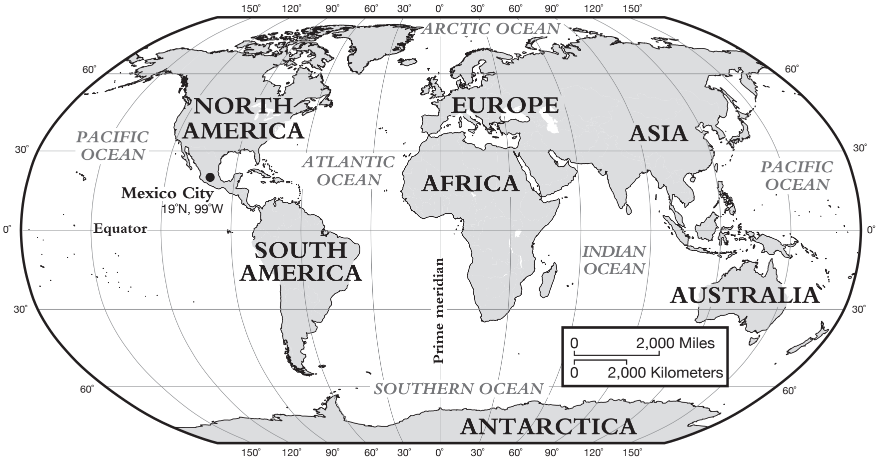
Spatial patterns refer to the general arrangement of phenomena on a map. Spatial patterns can be described in a variety of way utilizing important geographic tools and concepts including location, direction, distance, elevation, or distribution pattern.

Location

Locations may be absolute or relative. **Absolute location** is the precise spot where something is according to a system. The most widely used system is the global grid of lines known as latitude and longitude. **Latitude** is the distance north or south of the **equator**, an imaginary line that circles the globe exactly halfway between the North and South Poles. The equator is designated as 0 degrees and the poles as 90 degrees north and 90 degrees south.

Longitude is the distance east or west of the **prime meridian**, an imaginary line that runs from pole to pole through Greenwich, England. It is designated as 0 degrees. On the opposite side of the globe from the prime meridian is 180 degrees longitude. The **International Date Line** roughly follows this line but makes deviations to accommodate international boundaries. Thus, on this system, the absolute location of Mexico City is 19 degrees north latitude and 99 degrees west longitude.

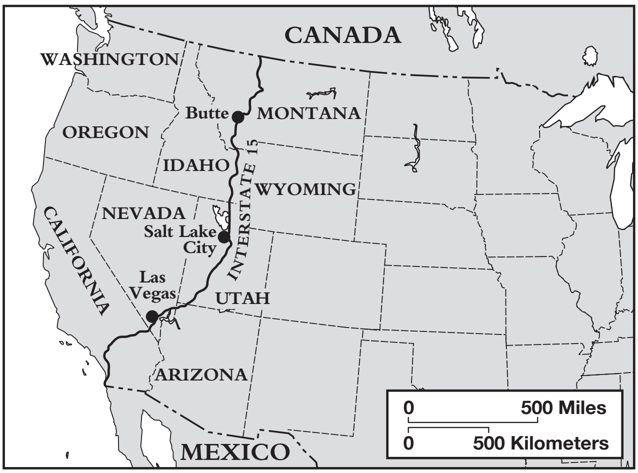
THE GLOBAL GRID



Relative location is a description of where something is in relation to other things. To describe Salt Lake City, Utah, as being "just south of the Great Salt Lake and just west of the Rocky Mountains, on Interstate 15 about halfway between Las Vegas, Nevada, and Butte, Montana," is one way (of many) to describe its relative location. Relative location is often described in terms of **connectivity**, how well two locations are tied together by roads or other links, and **accessibility**, how quickly and easily people in one location can interact with people in another location.

Direction is used in order to describe where things are in relation to each other. Cardinal directions such as north, east, south, or west or intermediate directions such as southeast or southwest are commonly used to describe direction. On most maps, north will be the top of the map, but be sure to look on the map for cardinal direction clues.

THE RELATIVE LOCATION OF SALT LAKE CITY



This map shows the relative location of Salt Lake City along Interstate 15. What are advantages for business or cities being located near an interstate?

Relative locations can change over time and as accessibility changes. For example, the many ghost towns (abandoned settlements) of the western United States once had relative locations near water sources (which dried up), along trade routes (which changed), or near mines (which closed). Their good relative locations lost the advantages of access to resources or trade that they once had. However, their absolute locations, as described by the global grid of latitude and longitude, remain the same.

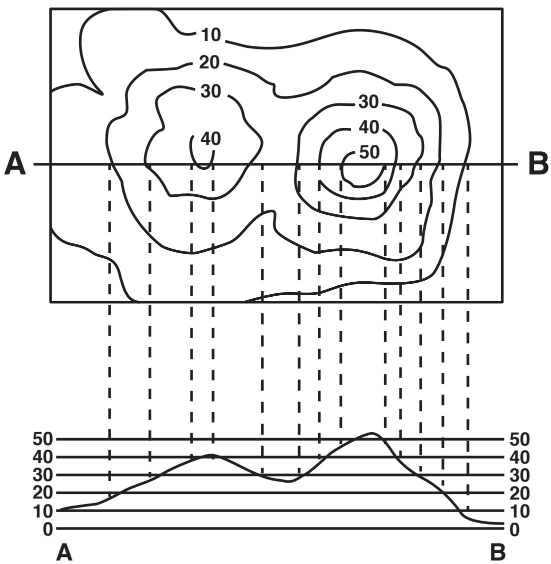
Distance

Distance is a measurement of how far or how near things are to one another. **Absolute distance** is usually measured in terms of feet, miles, meters or kilometers. For example, the absolute distance from home to your school is 2.2 miles.

The term **relative distance** indicates the degree of nearness based on time or money and is often dependent on the mode of travel. For example, traveling from home to your school takes 10 minutes by car or 25 minutes walking.

Elevation

Elevation is the distance of features above sea level, usually measured in feet or meters. The elevation of the summit of Mount Everest is over 29,000 feet. Elevation can impact a variety of things including climate, weather, and agriculture. Usually, the higher the elevation, the cooler the temperature gets and at very high elevations, it becomes more difficult for certain crops to grow. Elevation is usually shown on maps with contours (isolines).



Source: usgs.gov

A contour map (isoline), like the one above, shows elevation of physical features.

Pattern Distribution

Geographers are also interested in **distribution**, the way a phenomenon is spread out over an area (L2). Essentially, distribution is a description of the pattern of where specific phenomenon are located. Geographers look for **patterns**, or the general arrangement of things, in the distribution of phenomena across space that give clues about causes or effects of the distribution. Common distribution patterns include the following:

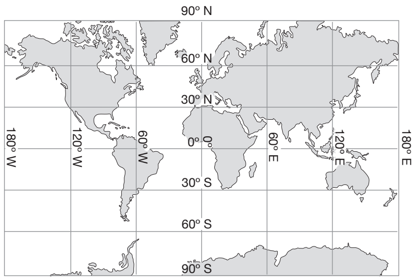
- **Clustered or agglomerated** phenomena are arranged in a group or concentrated area such as restaurants in a food court at a mall or the clustering of cities along the border of the United States and Mexico.
- **Linear** phenomena are arranged in a straight line, such as the distribution of towns along a railroad line.
- **Dispersed** phenomena are spread out over a large area, such as the distribution of large malls in a city.
- **Circular** phenomena are equally spaced from a central point, forming a circle, such as the distribution of the homes of people who shop at a particular store.
- **Geometric** phenomena are in a regular arrangement, such as the squares or blocks formed by roads in the Midwest.
- **Random** phenomena appear to have no order to their position, such as the distribution of pet owners in a city.

Projections

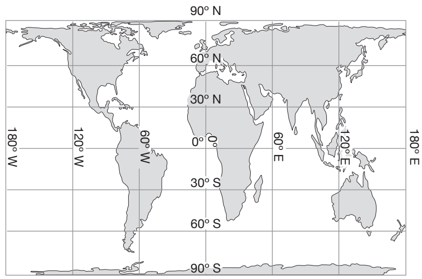
Because the earth is a sphere and maps are flat, all maps distort some aspect of reality. The process of showing a curved surface on a flat surface is done using a map projection. Cartographers decide whether they want to preserve area, shape, distance, or direction on their map accurately, knowing that other elements will have to be less accurate as the earth is “flattened” on their map. Essentially all maps are distorted, but cartographers use different maps for different purposes.

The Mercator, one of the most famous projections, was designed for navigation because the lines of directions are straight and easy to follow. A weakness of the Mercator on a global scale is that it makes the land masses appear larger than reality as you move north or south from the equator. This results in the countries of North America and Europe appearing larger and possibly more powerful than the countries near the equator. Greenland’s size on a Mercator looks to be the same size of Africa, however, in reality, Africa is 14 times the size of Greenland.

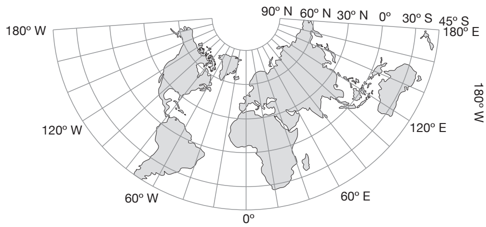
Geographers are concerned by the political and economic bias of power, wealth, and superiority that can be subconsciously reinforced by using an incorrect projection. All projections and maps have strengths and weaknesses. The key is to understand this and select the best projection for the map.



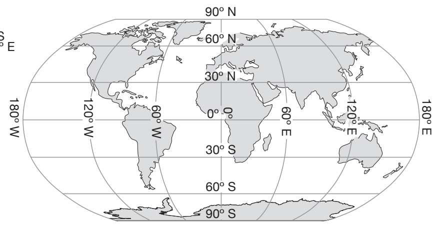
Mercator Projection



Peters Projection



Conic Projection



Robinson Projection

COMPARING MAP PROJECTIONS			
Projection	**Purpose**	**Strengths**	**Distortion (Weaknesses)**
Mercator	Navigation	▪ Directions are shown accurately ▪ Lines of latitude and longitude meet at right angles	▪ Distance between lines of longitude appears constant ▪ Land masses near the poles appear large
Peters	Spatial distributions related to area	▪ Sizes of land masses are accurate	▪ Shapes are inaccurate, especially near the poles
Conic	General use in midlatitude countries	▪ Lines of longitude converge ▪ Lines of latitude are curved ▪ Size and shape are both close to reality	▪ Direction is not constant ▪ On a world map, longitude lines converge at only one pole
Robinson	General use	▪ No major distortion ▪ Oval shape appears more like a globe than does a rectangle	▪ Area, shape, size, and direction are all slightly distorted

REFLECT ON THE ESSENTIAL QUESTION

Essential Question: *What information is presented in different types of maps, and how do those maps show spatial patterns, the power of geographic data, and relationships among places?*

Types of Maps	Types of Information in Maps	Ways to Describe Spatial Patterns

KEY TERMS

physical geography
human geography
Four-Level Analysis
analyze
theory
concepts
processes
models
spatial models
nonspatial models
time-distance decay
spatial patterns
networks
quantitative data
geospatial data
qualitative sources
scales of analysis
reference maps
political maps
physical maps
road maps
plat maps
thematic maps
choropleth maps
dot distribution maps
graduated symbol maps
isoline maps
topographic maps
cartogram
scale
cartographic scale
small-scale maps
large-scale maps
absolute location
latitude
equator
longitude
prime meridian
International Date Line
relative location
connectivity
accessibility
direction
patterns
absolute distance
relative distance
elevation
distribution
clustered (agglomerated) distribution
linear distribution
dispersed distribution
circular distribution
geometric distribution
random distribution

1.2

Geographic Data

Essential Question: What are different methods of geographical data collection?

Geographers often refer to the current era as being part of a geospatial revolution because they gather data through technical mapping and via satellites or aerial photos. Geographers also have the ability to gather data by visiting places, interviewing people, or observing events in the field. The quality of data gathered by individuals or institutions is important because patterns within the data will influence real-life individual choices and policy decisions.

Landscape Analysis

The word *landscape* comes from older Germanic words that refer to the condition of the land. The term can also imply a specific area, as in a "desert landscape" or the "landscape of Tuscany." The task of defining and describing landscapes is called **landscape analysis**.

Observation and Interpretation

The first part of landscape analysis is careful observation. Geographers are keen observers of phenomena and collect data about what they see. The term **field observation** is used to refer to the act of physically visiting a location, place, or region and recording, firsthand, information there. Geographers can often be found writing notes, taking photographs, sketching maps, counting and measuring things, and interviewing people as they walk through an area that they are interested in studying. For most of the history of geography, this was the only way to gather data about places. All of the information that can be tied to specific locations is called **spatial data**.

Developments in Gathering Data Modern technology has increased the ways in which geographers can obtain spatial data including remote sensing and aerial sources. **Remote sensing** gathers information from satellites that orbit the earth or other craft above the atmosphere. **Aerial photography**, professional images captured from planes within the atmosphere, is an important source of observed data available today. Ground-level photography has replaced sketching as a tool for capturing information about landscapes. Sound recordings and the ability to get chemical analyses of air, water, and soil have also changed the way geographers observe a landscape.

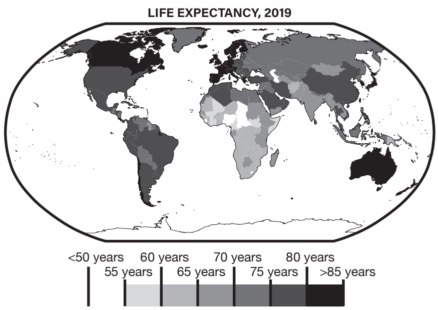
Interpreting Data Once data has been gathered, it must be interpreted. Geographers depend on their skills of synthesizing and integrating, or putting together, all of the collected information to better understand the place, area, or landscape being studied. A common example clearly observable today is the changes that occur in the landscapes of rural and urban areas over time. A geographer may be interested in understanding what changes are likely to occur as people move into or out of an area:

- Who are the people migrating into this area? Who is leaving?
- What are the cultures of these groups of people?
- What effects will the changes have on the local economy?
- What are the causes of people moving?
- What types of human-environment interaction are occurring?

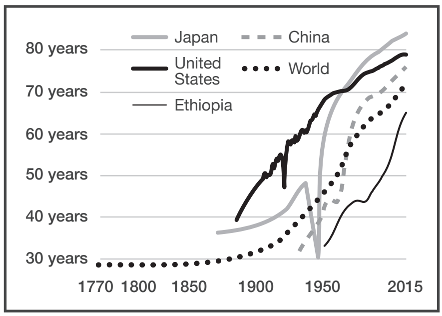
Geospatial Data

Geospatial data can be quantitative or qualitative and may be gathered by organizations or individuals. Geospatial data includes all information that can be tied to a specific place. Besides locations of things, such as mountains or roads or boundaries, it includes human activities and traits. Where do speakers of Mandarin live? How common is poverty in each U.S. county? Where is the dividing line in a city between students who attend one high school and those who attend another school?

SOURCES OF QUANTITATIVE DATA



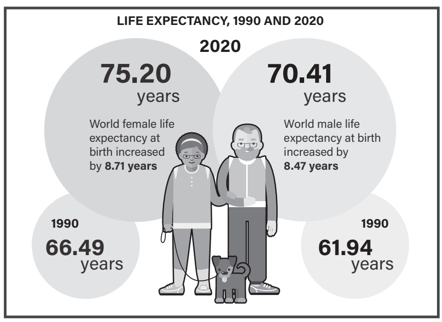
MAP



GRAPH

GLOBAL LIFE EXPECTANCY 2015 AND 2019				
Country	**2015**	**2019**	**Absolute Change**	**Realtive Change**
Afghanistan	63.4 years	64.8 years	+1.5 years	+2%
Africa	61.6 years	63.2 years	+1.6 years	+3%
Albania	78 years	78.6 years	+0.5 years	<1%
Algeria	76.1 years	76.9 years	+0.8 years	+1%
American Samoa	73.6 years	73.7 years	+0.2 years	<1%
Americas	76.4 years	76.8 years	+0.4 years	<1%
Andorra	83.1 years	83.7 years	+0.7 years	<1%
Angola	59.4 years	61.1 years	+1.7 years	+3%
Anguilla	81.3 years	81.9 years	+0.5 years	<1%
Antigua and Barbuda	76.5 years	77.9 years	+0.5 years	<1%

DATA TABLE



INFOGRAPHIC

Source: ourworldindata.org

The images illustrate different ways that quantitative geospatial data related to life expectancy can be presented. What are strengths and weaknesses of data presented in each image?

Obtaining Geospatial Data

Geographers collect geospatial data by doing **fieldwork**, or observing and recording information on location, or in the field. Important sources of this type of data can come from a census of the population, from interviews, or even from informal observations made by geographers. Land surveys, photographs, and sketches are also important ways in which this data is obtained. Technology is making the collection, storage, analysis, and display of geospatial data easier, as well as more accurate, than at any time in the past. The chart in Topic 1.3 illustrates three technologies that have revolutionized the importance of geospatial data.

Other Sources of Geospatial Data

Additional sources of data can come from government policy documents such as treaties or agreements, articles and videos from news media outlets, or photos of an area. Many tech companies who design apps for smartphones use locational data elements that make suggestions on food options or activities that are near to you. Most photos taken with smartphones have geospatial data embedded into the image that can be mapped in interactive online maps sites. In fact, many companies and some governments are interested in buying your smartphone geospatial data so they can make targeted advertisements or policy decisions related to your locational activities. Students of geography can be local geographers who gather information for projects or field studies.

Qualitative data can include photos (as of Tokyo to the left), satellite photos (as seen on page 2), cartoons, or interviews. How can qualitative data better help geographers to understand a place?

REFLECT ON THE ESSENTIAL QUESTION

Essential Question: *What are different methods of geographical data collection?*

Individual Sources	Institutional Sources

KEY TERMS

landscape analysis	spatial data	aerial photography
field observations	remote sensing	fieldwork

1.3

The Power of Geographic Data

Essential Question: What are the effects of decisions made using geographical information?

Geographic data is powerful. When used properly and ethically, it can have many positive benefits for individuals, companies, governments, and society. However, misusing it can lead people to draw inaccurate conclusions or make poor decisions. So, understanding the limitations of the data and carefully monitoring improper uses of this information are essential to ensure that the data is beneficial, not harmful, to individuals or a society.

Using Geographic Data to Solve Problems

There are many technological sources of geospatial data and many ways the data obtained from those sources is used in our everyday life. As computers and technology has rapidly improved, large quantities of information can now be rapidly gathered and stored. This data can then be turned into amazing 2D or even 3D interactive maps, or **geovisualizations**, that allow people to zoom in or out to see the data in ways that were previously impossible. When skillfully used, tools such as Google Earth, ESRI 3D GIS, OpenStreetMap, or the COVID-19 map (produced by Johns Hopkins University) allow viewers to see the world and data in new and interesting ways. These geovisualizations can help people better understand the world they live.

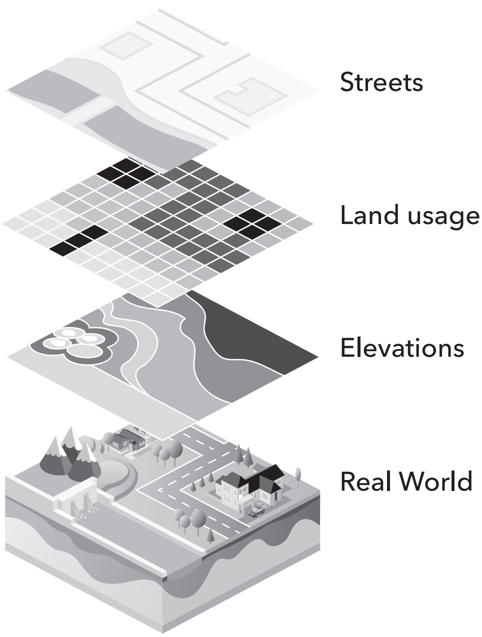
More importantly, the data helps solve real world problems. For example, accurately tracking and mapping the COVID-19 pandemic that began in 2019 resulted in saving lives in hot spots. At same time, it allowed areas that were less affected by the virus to open businesses and to allow students back into classrooms.

Even with all of these techniques, all data has limitations and geographers must be careful to accurately gather and interpret the data. Maps are only as valuable as the data used to create the map. Interview data may be from only a small percentage of the population and not represent all of the views in a community. Sometimes data sets may exclude segments of the population, such as the homeless or undocumented workers. A constant concern for geographers and others who interpret data is that people may make simple errors by typing information incorrectly into a computer.

These limitations may not make the data completely useless, but they can create gaps and inaccuracies in the data. Potentially, bad data can cause people using the map to draw inaccurate conclusions.

GEOSPATIAL TECHNOLOGIES		
Type	**Description**	**Uses**
Global Positioning System (GPS)	GPS receivers on the earth's surface use the locations of multiple satellites to determine and record a receiver's exact location	▪ Locating borders precisely ▪ Navigating ships, aircraft, and cars ▪ Mapping lines (trails) or points (fire hydrants)
Remote Sensing	The use of cameras or other sensors mounted on aircraft or satellites to collect digital images or video of the earth's surface	▪ Determining land cover and use ▪ Monitoring environmental changes ▪ Assessing spread of spatial phenomena ▪ Monitoring the weather
Geographic Information Systems (GIS)	Computer system that can store, analyze, and display information from multiple digital maps or geospatial data sets	▪ Analyzing of crime data ▪ Monitoring the effects of pollution ▪ Analyzing transportation/travel time ▪ Planning urban area
Smartphone and Computer Applications	Location-aware apps that gather, store, and use locational data from computers or other personal devices	▪ Suggesting restaurants, stores, or best routes to users ▪ Contact tracing related to tracking diseases or exposure to chemicals ▪ Mapping of photos from geotags

GEOGRAPHIC INFORMATION SYSTEMS (GIS)



GIS are computer-based tools that are used gather, manage, and analyze data related to position on the Earth's surface

Solutions in Action

Geographers can use geospatial data tools to identify problems that exist in our world such as water shortages, potential famine, or rising conflicts. One case study involves the people of the Nuba Mountains in Sudan. Using maps and remote sensing technologies, such as satellite and aerial images, researchers observed possible humanitarian concerns. These concerns were related to conflicts in the area that resulted in a lack of access to clean drinking water or infrastructure such as hospitals or schools. A team of researchers decided to visit the community in order to assess the situation from the ground using landscape analysis techniques. The hope was to develop a **community-based solution** and the power of governmental and non-governmental organizations (NGO) to help the people improve their standard of living. Community-based solutions increase the likelihood of success because they create buy-in from local residents and are more likely to be culturally accepted. As a result, geographers and Sudanese family members living in the United States are working with organizations such as the Nuba Water Project to develop solutions to bring better access to water, medicine, and education to the people of the Nuba Mountains in Sudan. Geography in action!

Source: cosv.org

Many people in Africa struggle with access to clean drinking water. This water pumps provides access to water for young girls their family in Darfur Sudan. Why is cooperation with the local community and researchers important?

REFLECT ON THE ESSENTIAL QUESTION

Essential Question: *What are the effects of decisions made using geographical information?*

Sources of Geospatial Data	Benefits of Using Geospatial Data

KEY TERMS

- geovisualization
- Global Positioning Systems (GPS)
- remote sensing
- Geographic Information System (GIS)
- community-based solutions

GEOGRAPHIC PERSPECTIVES: *THE LONDON SUBWAY MAP*

One of the most useful maps in history is also one of the most inaccurate. And its inaccuracies are what make it so useful. The map of the London subway system, known as the Underground, demonstrates the value of the concept of relative location. A portion of this map is shown below.

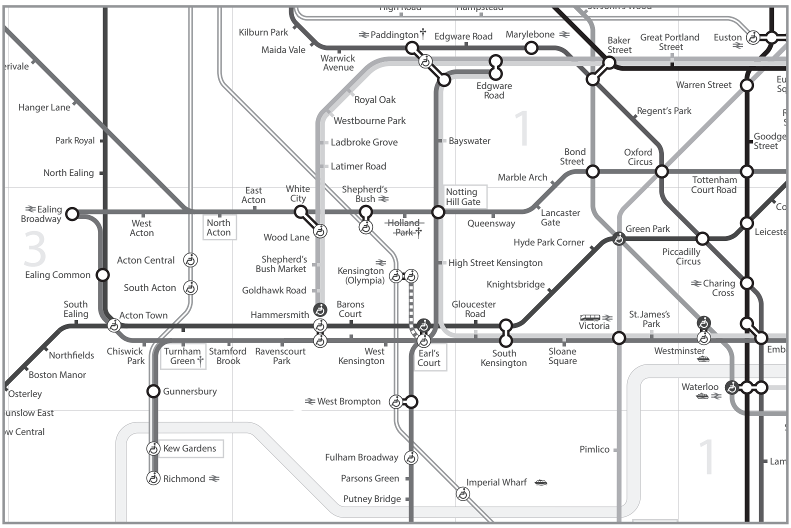
Beck's Map

By 1931, the Underground had become so complex that an accurate but conveniently small map was hard to read. Harry Beck, an Underground employee, realized that a simpler map would be more useful. Passengers did not need to know every twist and turn in the routes, so he created a map with straight lines. Passengers were also not particularly concerned with distances, so he adjusted the space between stops on the map. He spread out the ones in the congested central city and reduced space between the outlying stops so they fit on the map easily.

The result was a map based on relative location that was easy to read and convenient to use. Passengers knew where to get on, where to get off, and at which stops they could transfer from one line to another.

Popular Demand

When the first version of the map was distributed to a few passengers in 1933, people demanded more. Since then, the map has been revised regularly to add new subway lines, more information about which lines have limited service, which stations are accessible to people using wheelchairs, and other improvements. Other transit systems have adopted a similar approach.



1. Even though the underground map has inaccuracies why is it still useful?
2. What other maps do you find useful that may have some inaccuracies? Explain.

THINK AS A GEOGRAPHER: *GROUPING DATA*

How people group information can emphasize certain patterns in the data. In turn, this can influence how readers interpret it. Imagine you are creating a map based on the data in the table.

POPULATION CHANGE FOR THE LARGEST CITIES, 1900 TO 2015				
City	**Population in 1900**	**Population in 2015 (estimate)**	**Total Change**	**Percentage Change**
New York	3,437,202	8,550,405	+5,113,203	+149%
Chicago	1,698,575	2,720,546	+1,021,971	+60%
Philadelphia	1,293,697	1,567,442	+273,745	+21%
St. Louis	575,238	315,685	–259,553	–45%
Boston	560,892	667,137	+106,245	+19%
Baltimore	508,957	621,849	+112,892	+22%
Cleveland	381,768	388,072	+6,304	+2%
Buffalo	352,387	258,071	–94,316	–27%
San Francisco	342,782	864,816	+522,034	+152%
Cincinnati	325,902	298,550	–27,352	–8%

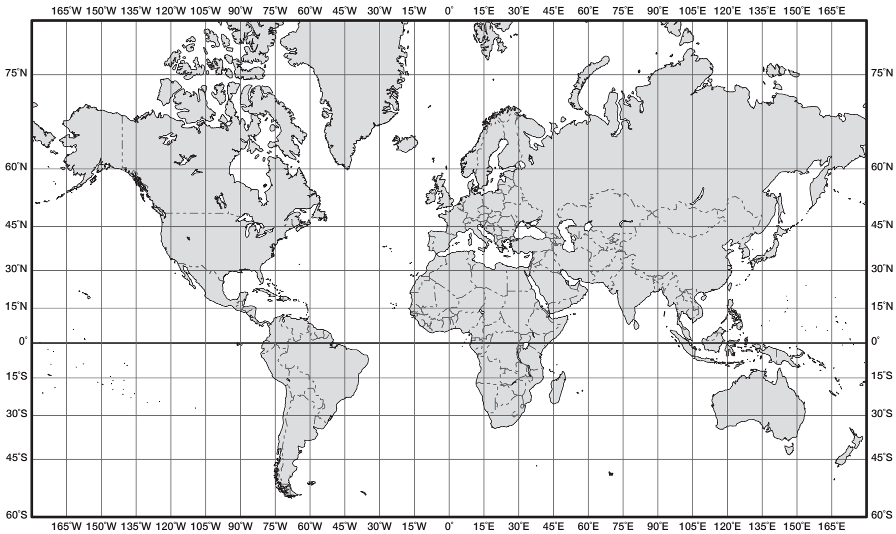
1. If you use large dots to show cities of three million or more people in 1900 and small dots for the other cities, what impression would the map give readers about the relative size of cities?
2. If you use large dots to show cities of 600,000 or more people in 1900 and small dots for the other cities, what impression would the map give readers about the relative size of cities?

CHAPTER 1 REVIEW:
Maps and Geographic Data

Topics 1.1–1.3

MULTIPLE-CHOICE QUESTIONS

Questions 1 and 2 refer to the map below.



1. Why is the map projection shown here especially useful for navigation on the surface of the earth?

(A) Distortion of shape is minimized.

(B) Direction is constant across the map.

(C) Distances are correctly portrayed.

(D) Area of land masses is shown accurately.

(E) It shows the sizes of bodies of water realistically.

2. Like the map above, all maps have some kind of distortion. Why?

(A) The earth's surface is curved and a map is flat.

(B) All maps are smaller than the areas they actually represent.

(C) Human error is always present when a map is made.

(D) Maps can depict only a small number of the many details of the earth's surface.

(E) The world constantly changes, so maps are never current.

3. Which phrase refers to the collection of geospatial data through the use of satellite imagery?
   (A) Creating a projection
   (B) Gathering information through fieldwork
   (C) Using a global positioning system
   (D) Forming a mental map
   (A) Using remote sensing

4. Which is the best example of qualitative data used by geographers?
   (A) Personal descriptions of processes and events
   (B) Surveys about how often people visit other places
   (C) Census counts such as population statistics
   (D) Measurements of distance made using GPS receivers
   (E) Tables showing the age distribution of people in a community

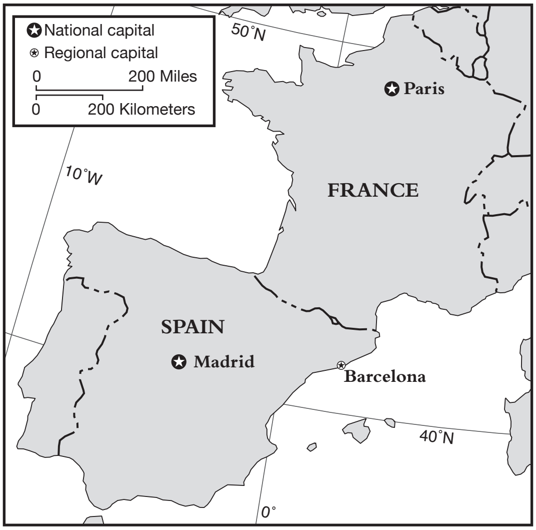
Question 5 refers to the passage below.

Smartphones, each one with a tiny GPS pinging, have revolutionized cartography. Matthew Zook, a geographer at the University of Kentucky, has partnered with data scientists there to create what they call the DOLLY Project (Digital OnLine Life and You)—it's a searchable repository of every geotagged tweet since December 2011, meaning Zook and his team have compiled billions of interrelated sentiments, each with a latitude and longitude attached.

—Christian Rudder, "The United States of Reddit," *Slate*, 2014.

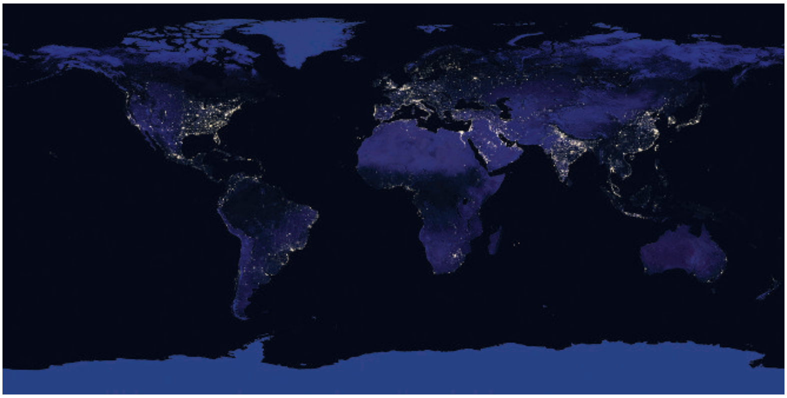
5. Why are geographers interested in the information in DOLLY?
   (A) It provides information about spatial distribution of people's reactions to events.
   (B) It provides an opportunity for geographers to work with data scientists.
   (C) Geographers focus on the sentiments of people more than do other scientists.
   (D) Geographers are more likely to use new technology than are other scientists.
   (E) The data is searchable, and most geographic information is hard to organize.

Questions 6 to 7 refer to the map below.



6. Which statement best describes the absolute location of Paris, France?
   (A) 127 miles away from the English Channel
   (B) In the Northern Hemisphere and Eastern Hemisphere
   (C) 49 degrees north, 2 degrees east
   (D) The capital of France
   (E) In the heart of France

7. Which statement describes the relative location of Barcelona, Spain?
   (A) The capital of the Catalonia region
   (B) 41 degrees north, 2 degrees east
   (C) In the Northern Hemisphere and Eastern Hemisphere
   (D) 386 miles west of Madrid and 644 miles south of Paris
   (E) One of the largest cities in Spain



1. Use the image of Earth at night above, your knowledge of Four-Level Analysis, and the course skills to answer the prompts. Also refer to the introduction discussion on verbs (page xxx) to assist you on how much to write for each part of the question.
   (A) Identify the overall scale of the Earth at night image.
   (B) Describe TWO patterns on the map.
   (C) Explain why the Earth at night image is considered a qualitative source and not quantitative.
   (D) Explain ONE reason why eastern China is brighter than western China.
   (E) Explain ONE economic impact of so many people living on the coasts of the world's continents.
   (F) Explain ONE environmental impact of so many people living on the coasts.
   (G) Describe a major limitation of using the Earth at night image to illustrate the location of the world's population.